Heuristic Theorizing in Software Development: Deriving Design Principles for Smart Glasses-based Systems

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Abstract. Design knowledge on smart glasses-based systems is scarce. Utilizing literature analysis on software development publications, insights from the design and implementation of four smart glasses-based systems and expert interviews, we elicited 16 design principles to provide guidance in the development of future service support systems. Heuristic Theorizing is an abductive Design Science Research method, hitherto far too little known or little noticed, which was applied to conduct the research. We contribute to theory and practice with applicable design principles to support the development of smart glasses-based systems. Phenomena known to have an impact on the adoption of smart glasses are addressed by these design principles.

Keywords: Smart Glasses, Augmented Reality, Design Principles, Heuristic Theorizing, Instantiation

1 Introduction

Digital transformation is characterized by unavoidability, irreversibility, rapidity and uncertainty [1]. Thereby an essential driver for today's digitalization are mobile technologies [2]. In this domain Augmented Reality (AR) reached much attention in research and practice. Haborth [3] discovered that a dominant technical research focus exists and inevitably studies regarding user behavior are underrepresented. However, a holistic knowledge is essential for the adoption of new technologies [4].

One technology to take into consideration are smart glasses. Smart glasses-based systems are identified as an appropriate solution to assist services with intense information-needs [5], [6]. Based on three years of research and a certain amount of smart glasses-based prototypes we define the corresponding concept as a mobile eyewear having a display and further sensors installed, in sum called smart glasses, which proactively provides process information and instructions to the user or allows the user to collaborate with integrated IT-systems (Human-Computer Interaction) or other process participants. For example, by using integrated cameras the user is able to scan bar codes or to take pictures and videos while executing assigned tasks. As a

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further benefit, a valid smart glasses-based system allows a hands-free interaction and therefore releases further efficiency. The underlying technology Augmented Reality is a generic technical concept, which describes displays that enhance the perceived real world by digital and virtual objects [7]. Smart glasses-based systems are discussed in particular to cope with the variety and wide range of service tasks [8].

New technical features exist that (amongst others) can track the user and take photos unnoticedly. Therefore, privacy is a vital issue not only in terms of compliance, but for user's trust and perceived privacy. Potential users refrain from the adoption of smart glasses as they criticize privacy risks as well as ergonomic and social consequences following the use of smart glasses [9]. To ensure the adoption of this promising support technology, iterative adjustments are required to design and implement smart glasses-based systems to encounter existing adoption barriers [10]. A research gap exists thereby because those systems are still under ongoing investigation and have not been fully implemented in practice to date. Due to a small number of cases, the factors and phenomena influencing the adoption and diffusion of smart glasses are not fully understood [11]. Hence, the research focus of this paper is embedded in a design science research (DSR) project that deals with the global research question:

(RQ) *How to design smart glasses-based systems for industrial service scenarios aiming to positively influence adoption and diffusion?*

During a three-year consortium research, we investigated the design and development of smart glasses-based systems. Uncertainties arose in terms of implementation, usability, privacy, acceptance, and project management resulting from the aforementioned research gap. Heuristic can be understood as an approach to handle situations where limited time and knowledge are involved in achieving with a high probability suitable solutions. This is in contrast with the imagination of unlimited rational thinking and resources to find out the optimum [12]. Marewski et al. [13] figured out that heuristics, i.e. simple cognitive approaches, can be in favor when uncertainty is involved due to omitting insignificant details. Heuristic Theorizing [14] is applied in this context to structure the problem space and generate regarding solution components in an iterative approach. Then, we combined our justificatory knowledge of smart glasses-based system development with design principles from IS literature.

Our presentation of research is structured as follows: To begin with, the theoretical background of smart glasses, their implications for service support systems and research projects, which applied Heuristic Theorizing are presented (cf. section 2). Afterwards, we introduce Heuristic Theorizing as our research approach and apply it to the initial research questions (cf. section 3). This is followed by detailed explanations of our execution (cf. section 4). Then we describe the derived design principles (cf. section 5) and state hardware guidelines (cf. section 6). We conclude with discussion and further research need statements (cf. section 7).

2 Related Work

Smart devices appear in everyday objects that become omnipresent and allow interconnection to a smart environment. Popular manifestations of smart devices are smart glasses [11]. The main advantage of smart glasses are the hands-free navigation and context-sensitive information provision [15], [16]. Smart glasses are in particular applicable to information-intensive and bi-manual tasks. However, potential users criticize privacy risks as well as ergonomic and social consequences following the use of smart glasses [9]. In IS research, several models and theories are applied to explain and measure the technology acceptance. Due to a small number of cases, the determinants for the acceptance of smart glasses are still not fully understood [11]. First articles in the IS domain present prototypical implementations of smart glasses-based service support systems and describe their individual and domain-specific design process (cf. [8], [17–22]). These researchers built on general guidelines for human-computer interaction (cf. [23–25]) or design guidelines provided by manufacturing companies such as Google [26] and Sony [27]. A few approaches aim to derive design principles for smart glasses-based service support systems, but again these are limited to individual use cases and domains [18], [28].

However, design guidelines and principles in human-computer interaction for an application must be extended and adapted to specific hardware Design knowledge on smart glasses-based service support systems is scarce and limited in their generalizability [cf. 28]. Design guidelines provided by the manufacturers are specific to individual models and focus on UI design [26], [27]. As this disruptive technology is part of a sociotechnical system, principles regarding the interaction, information provision and implementation in an existing system landscape are necessary. Design Principles convey prescriptive design knowledge provided by DSR [29]. This prescriptive knowledge results from the generalization of experiences and knowledge from individual implementations. In the course of research, we applied a heuristic approach to derive such design principles for smart glasses-based systems, because heuristic thinking is useful in design situations with high uncertainties [30]. For instance, Lienhard and Legner [31] used Heuristic Theorizing in a research project to evolve design principles for mobile health apps.

3 Research Approach

Heuristic Theorizing [14] was applied as a research strategy during an iterative system development grounded in a three-year consortium research. This DSR method is characterized by the use of heuristics to design a satisficing solution for an unstructured problem space. The design and implementation of smart glasses-based systems is such an unstructured problem space, because of the lack of design knowledge. Therefore, the entry point is the research gap for the design smart glasses-based systems. This problem space was structured continuously with reoccurring “problem structuring heuristics”. The findings are concretized and translated into action with the use of “design heuristics”. Results from heuristics are extracted through “heuristic synthesis”. The applied heuristics served to build a satisficing solution in the form of (i) four prototypes and (ii) 16 design principles to design and develop smart glasses-based systems. The alternating phases of heuristic synthesis and problem structuring/ design heuristics supported the course of research with dynamic problem-solving approaches.

Figure 1 states the methods applied as heuristics and the main artifacts that result from the synthesis. The sequence of steps that we passed through in order to derive design principles for smart glasses-based systems by using Heuristic Theorizing is traced with numbers in ascending order from (1) to (17). The designed principles are deduced from scarce design knowledge in IS literature [32], experiences made in the design and instantiation [33] of smart glasses-based systems and expert interviews [34] with AR software engineers.

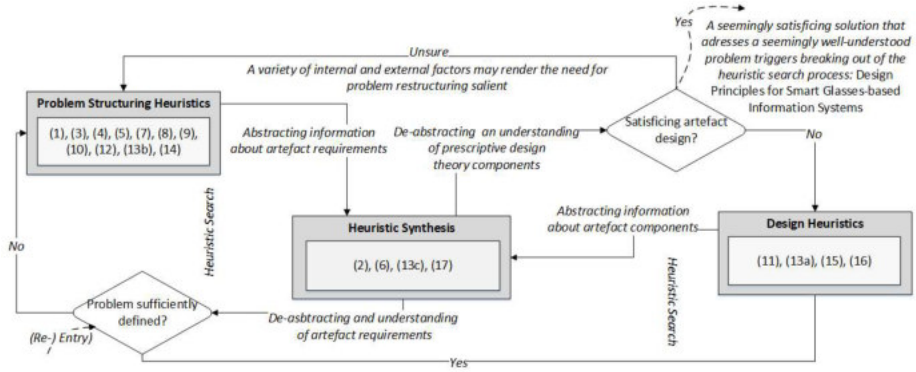

Figure 1. Applied process of Heuristic Theorizing

4 Executing Heuristic Theorizing

Overall, we applied nine different heuristics during research. To conduct the heuristic search, we used established *design science research methods and patterns* as published by Vaishnavi and Kuechler [35]. Initially, we *decomposed the research problem (1)* to identify the essential aspects of the research questions and to form the central problem class "design know-how for smart glasses-based systems" *(2)*. With an *interdisciplinary problem extrapolation (3),* we searched for existing solutions within other scientific disciplines such as law and psychology as well as solutions from practice. We found prototypes and studies from the field of logistics [36], manufacturing [37] and technical customer services [8], as well as design guides for user interfaces of AR or smart glasses [26], [27], [38]. Relevant knowledge was identified through *familiarization with the research community (4)* and the analysis of the *industry and practice awareness (5)* on smart glasses-based systems. The design then was enriched during the prototyping with insights from practice. We based our prototypes' design on already *published design solutions (6)*, both from research and from smart glasses producers [8], [26], [27], [39].

For the instantiation of our concept, we *identified a research domain (7)* and focused on a use case in logistics services as it inherits a linking function in the supply chain and provides numerous services, such as value-added services, which are highly intertwined with other industries. As we identified our research domain, we examined the *industry and practice awareness (8)* for smart glasses-based solutions in this specific sector again and collected requirements, challenges and potentials by conducting *expert interviews (9)* and a *systematic literature review (10)*. These expert interviews were conducted in the form of eight focus groups (two per prototype) consisting of three researchers (two from IS, one from logistics), two domain experts from logistics and two implementers of logistics systems. During these sessions, we discussed potential use cases for smart glasses in logistics and derived requirements for the prototyping. For an instantiation, the selection of the logistics domain is suitable as their workflows are characterized as information intense services with high flexibility [40]. Furthermore, smart glasses-based systems offer great potentials to improve logistic services. Potential use cases within the standard business processes in intralogistics have already been analyzed [41].

Software development activities, supported by design drafts *sketching possible solutions (11)*, were validated in four *expert interviews (12)* from the same group as before. Including the resulting feedback, four applications for smart glasses were developed through *iterative prototyping (13.a)*. In a cyclical attempt, we evaluated the applications using *experimentation and exploration (13.b)*. In a first step, students tested the applications and gave feedback. In a second step, the applications were tested with employees from logistics companies at real workstations. The feedback was collected in particular through discussions with the scientists involved and by applying the thinking aloud method. Four *smart glasses-based systems* for logistics support resulted from this approach *(13.c)*.

The four systems provide functionality for four different use cases. With system A, logistics workers can document damages of incoming goods by making use of the built-in camera. System B guides employees through the assembly processes of value-added services. System C provides a documentation method through a checklist-based approach for quality assurance, replacing paper-based lists. With system D, users can record processes while executing the respective tasks at the same time, which are then transformed into standardized process models automatically. While system A was developed for the Vuzix M100 smart glasses, the other three systems were built for its successor, the Vuzix M300. All four systems have been tested and evaluated by domain experts in real application cases. Major problems we identified in the course of research are the system's acceptance, usability, the ergonomic design, privacy and safety. We adapted the technical and functional design aspects regarding a modular architecture, measures to address acceptance and privacy compliance and included further aspects of the user interface and interaction patterns for smart glasses-based design. Unfortunately, adjustments for an improvement of the ergonomic design were limited due to the hardware. An example for the user interface and provided functionality of such system can be seen in Figure 2 (cf. section 5).

Investigating generalizability (14) of our design knowledge, we aggregated the similarities in problems and solutions among the four prototypes together with the participating developers to deduce the first set of *design principles (15)*. For evaluation this set was retrospectively discussed and was further supplemented in *interviews (16)*. One interview was conducted with the two implementation experts from the earlier interviews and one was conducted with two AR experts from a so far uninvolved software development company. The concepts and lessons learned from the development and implementation of the four systems were *embedded (17)* with the insights from literature and practice The three researchers mentioned have independently carried out a qualitative content analysis [42] and compared and integrated the results afterwards to develop a set of 16 design principles for smart glasses-based systems. Table 1 (cf. Appendix) states from which sources each design principle originates. In contrast to Niemöller et al [8], the proposed design principles are not based on a single implementation but integrate findings from four prototypical implementations and design knowledge from IS literature.

5 Design Principles

Overall, we identified 16 design principles, which we structure into four superordinate categories based on the architectural pattern of Model-View-Controller [43]. The category Interaction Design represents the controller (C), the category Software Design and Architecture serves as model (M). As smart glasses pose unique challenges concerning the presentation of data, the view-component (V) was divided into the categories Information Provision and User Interface, to state *which* and respectively information should be presented. Figure 2 states a summary of the proposed design principles. The design principles convey descriptive knowledge gained from the before mentioned DSR project and design knowledge from literature (cf. Table 1). This manifold design knowledge has been translated into action and materiality oriented [29] design principles. However, Information Provision deviates from this; these principles have been developed with a view to action as action-oriented design principles.

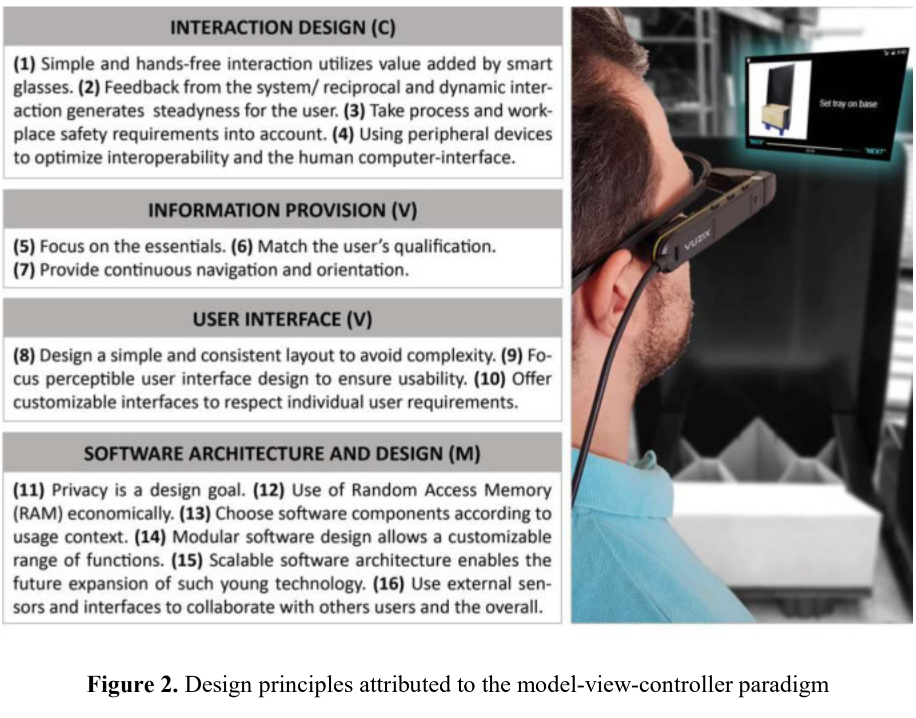

Figure 2. Design principles attributed to the model-view-controller paradigm

5.1 Interaction Design (C)

(1) Simple and hands-free interaction utilizes value added by smart glasses. To keep both hands free for bimanual tasks, e.g. picking of goods, voice control is favorable [21]. However in louder conditions, voice control can be distracted by noise or other voices. Alternative solutions such as gesture control or external control buttons should therefore also be provided.

(2) Feedback from the system/ reciprocal and dynamic interaction generates steadiness for the user. The feedback given by the smart glasses is important for the user's orientation among his tasks. To not lose track of the workflow, the user has to be informed about his handling errors and successful inputs [18], [21]. If voice control is deployed, the status of speech recognition should be displayed and an acoustic feedback could be implemented. We experienced confusion and mishandling if the user does not receive feedback on the status of data processing. If virtual objects are displayed in a smart glasses-based system with spatial localization, direction indicators should be implemented to guide the user to objects, which are placed outside his current field of view.

(3) Take process and workplace safety requirements into account. Smart glasses are deployed in industrial settings with potential dangerous conditions and processes. To safe the user from imminent danger, giving input during safety warnings should be disallowed. Regarding binocular devices, a half display mode, e.g. for forklift drivers, to ensure an unaffected perception of reality combined with larger font sizes during movement activities seem to increase the safety at work even further.

(4) Using peripheral devices to optimizes interoperability and the human-computer interface. Smart glasses as a standalone solution have limited resources. The connection of smart glasses with peripheral devices (e.g. telemetry sensors) increases the application potential and, for instance, enables smart services [8]. The possibility of a wireless connection to the internet makes online communication (e.g. video chat) possible [28]. Interoperability with other devices or the interaction with machines that are part of the user's working place can enhance the support of complex or collaborative tasks.

5.2 Information Provision (V)

(5) Focus on the essentials. Minimalistic and context-adaptive information provision and one main screen with crucial information about the task to fulfill, prevent the occurrence of information overload and cognitive stress [8]. Additional information of the displayed process should be attached and split into multiple screens if it is to complex or too much content [8]. To reduce confusion and to not lose track of the workflow, hierarchies should be kept flat, messages should be short and concise [27]. Complex structures also have to be avoided due to limited legibility and cognitive stress. Instead of this, physical objects seem suitable [38]. Finally, the navigation depth should be as small as possible to prevent information overflow and cognitive stress [8].

(6) Match the user's qualification. An information provision that matches the user's qualification leads to a higher acceptance and a better user experience. For example, novices might require additional information, while this additional information is redundant for experts. Moreover, the full workflow should be represented by one smart glasses device. This prevents media disruption and improves the acceptance and user experience [8].

(7) Provide continuous navigation and orientation. Avoiding the unexpected, e.g. sending content too frequently and at unexpected times, helps to increase acceptance and usability [26]. Providing a progress bar to keep track of information and always returning to the last shown step are also supporting acceptance and usability [8]. Recognizable icons guiding the user and let him know immediately about the meaning of the corresponding message. To allow direct feedback to one step is also improving the usability [8].

5.3 User Interface (V)

(8) Design a simple and consistent layout to avoid complexity. Complex and dynamic layouts impede the usage of smart glasses. The following features decrease such complexity: Virtual screens and look-around displays should have no more than three colors maximum [21], [26], [44]. The Information should be placed in the (lower) center of the screen [21], [44], navigation bars at the bottom [21], [26]. Intuitive elements, such as icons, find their place in the corners of the display [26]. A dark background for look-around displays or to display 2D objects is desirable. An adaptable mode for different usage contexts (e.g. day and night mode) is useful.

(9) Focus perceptible user interface design to ensure usability. To deliver a good perceptibility, it is important to use an appropriate font size and type [27]. Recognizable icons enhance an intuitive use and reduce complexity. In regards to AR glasses with spatial localization, depth cues for virtual objects and a well-suited field of view increase immersion and are crucial for a comfortable head movement [38]. Finally, real world objects should not be covered by virtual content. Digital objects should be placed in open spaces [38].

(10) Offer customizable interfaces to respect individual user requirements. The user should be allowed to adapt the colors and positioning of elements to match their individual requirements and information needs. As a consequence, stronger involvement of the user results and seem to lead to higher acceptance [28].

5.4 Software Design and Architecture (M)

(11) Privacy is a design goal. Security breaches and client insecurity, privacy risks as well as General Data Protection Regulation (GDPR) compliance are common problems with smart glasses that should be avoided. As a result privacy by design and default are central rules to be followed for smart glasses-based systems. Therefore, latest data security measures have to be taken [45]. Moreover, a transparent system architecture as well as a transparent data collection and storage increase the trust in the system and in doing so the users acceptance [27], [45].

(12) Use Random Access Memory (RAM) economically. The main goal of all measures regarding the economical use of RAM deals with a lack of battery power, heat generation, and speed reduction as well as stability problems. These issues are caused by still constrained hardware setups of latest smart glasses devices. The downscaling of images and the avoidance of unnecessary elements and activities reduce the extent of RAM use and therefore increase the performance as well as user experience of the smart glasses-based application.

(13) Choose software components according to the usage context. To meet the device properties and the system requirements, deploying a sufficient framework is important to meet the device properties and the system requirements. One the one hand significant factors for the choice of an implementation framework, are hardware, the complexity of the task, support and scalability. On the other hand, solution components may vary with the usage context and therefore require a certain level of flexibility. For example, in most cases integrated voice commands like a "Next" voice statement are sufficient to complete a task rather than implementing a cloud-based speech-to-text service (even causing further issues with regards to DP 11). According to the usage context of the resulting support system, corresponding applications may use different functions of the system. For example, different options of voice control can be applied (command vs. speech-to-text) instead of single commands (e.g. "say what you see" principle. Also, connectivity, algorithm, implementation effort and the level of maturity are the deciding factors for the choice of voice control as some require an internet connection.

(14) Modular software design allows for a customizable range of functions. A modular design of system components enhances scalability and customization. Turning off unnecessary functionalities (modules) for specific use cases, receives several benefits regarding privacy compliance, the complexity of the system and the extension of RAM usage.

(15) Scalable software architecture enables the future expansion of such young technology. The system should be maintainable, expandable and scalable to meet an increasing demand and technical evolution.

(16) Use external sensors and interfaces to collaborate with others users and the overall system environments. Based on an increasing amount of sensors around the company landscape, mainly driven by Internet-of-Things concepts, there is a great potential to access process data, e.g. watching live machine utilization or being informed in case a new truck is arriving. Furthermore special peripheral devices like hand-mounted scanners utilizing additional process performance.

6 Hardware-specific Guidelines

During the course of research we additionally identified actionable guidelines for the choice and preparation of hardware. As these hardware guidelines occurred as a byproduct of our discussions and information generating methods, they were not integrated into the previously presented design principles. Nevertheless, they serve as important insights concerning the choice and handling of smart glasses.

Ensure wearing comfort. Regarding the Hardware Design, ensuring the wearing comfort of smart glasses is the first identified guideline. Poorly balanced as well as a too heavy weighted devices may lead to muscular pain and discomfort during a long working day [46]. A flexible position of the display supports wearing comfort by providing a better individual perceptibility [18]. The stable attachment of the smart glasses at the head further enhances the wearing comfort during movement. To meet individual demands, the suitability of the devices for spectacle wearers and mounting options for both eyes are necessary.

Choose hardware usable in industrial settings. The application of smart glasses in an industrial context leads to specific requirements. The consideration of industry standards is crucial with regard to the acceptance of smart glasses [8], [28]. Certain working contexts such as outdoor or soiled environments require waterproof and shockproof housing. Clip-on solutions are favorable for mounting on existent equipment, to be compliant with safety regulations in many industries.

Minimalistic Hardware Design. Complex and fragile hardware impedes the adoption of smart glasses [8], [28]. Consequently, the functionalities should match the usage context, and unnecessary functions should be avoided. The outsourcing of computational power as well as the battery, combined with high mobility are also important factors to minimize the hardware. A modular system would comply with the privacy by design paradigm [45], because the built-in sensors and functionalities are limited to the usage scenario.

Ensure excellent legibility. The legibility of smart glasses displays depends on technical as well as environmental conditions and has to suit the individual requirements of the user. Adjustable brightness, high resolution, and protection against solar radiation are crucial for excellent legibility of the display [28], [38].

7 Discussion, Conclusion, and Outlook

Discussion. Through applying heuristic theorizing, we introduced design principles for smart glasses-based systems. These design principles enrich previous research [6], as they focus on how software for smart glasses should be designed and developed. We contribute to the limited knowledge-base of smart glasses-based system engineering by providing results from the successful application of Heuristic Theorizing [14], an appropriate method for systems engineering which hitherto is not very known in research. We designed and instantiated four systems on two different hardware models. Hitherto, an evaluation has been carried out in the form of an interview with implementation experts. The effectiveness of the proposed design principles was not part of previously documented studies, and hence needs to be addressed in subsequent steps. The design principles for look through devices with spatial localization originate from literature and expert interviews. Further instantiations are required to extend the specific design knowledge within the range of those smart glasses.

Conclusion. In a DSR approach, we utilized design knowledge published by IS scholars and smart glasses-producers, the design and instantiation of a smart glasses-based system and expanded these findings with knowledge provided by augmented reality software engineers. The lack of long-time experience with smart systems demands the adaption and extension of best practices to meet the requirements emerging with the implementation in business settings and to derive design knowledge for future implementations. Heuristic Theorizing enables the integration of scientific insights to meet the requirements of innovative technology. As an open and creative process, it contributes new insight and is beneficial to the artefacts for practical use.

With our research, we contribute to theory with design principles for smart glasses-based systems. The aggregated design principles address the phenomena of acceptance and privacy, as crucial factors for the fail of smart glasses on the consumer market, as well as usability and ergonomic design. Furthermore, the paper presents a respective domain that is affected by the digital transformation and demonstrates with the application of Heuristic Theorizing an approach to handle digitalization research projects.

Outlook. Technology acceptance and usability of pervasive computing such as smart glasses is not understood, yet. Especially impediments in smart gasses adoption such as acceptance [47] require further understanding. Therefore, influence factors regarding those devices need to be examined and integrated into theories for technology acceptance [11]. To spark future research, the presented design principles can further be validated, expanded and refined through further case studies. A combination of our findings with further insights from the research community and particularly from interdisciplinary areas, e.g. from cognitive science, psychology and ergonomics, is planned to deepen the understanding of phenomena influencing the adoption of smart glasses-based systems.

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Appendix

Table 1. Design principles grounded in literature and design heuristics

Design Principle	Literature	Design Heuristics	Example
(1) Simple and hands-free interaction utilizes value added by smart glasses.	[8], [18], [21], [28]	Sketching Solution	For actual freehand use, only voice control comes into question. Gesture recognition or input using buttons temporarily require at least one hand.
(2) Feedback from the system/ reciprocal and dynamic interaction generates steadiness for the user.	[18]	Iterative Prototyping	Users were irritated when the system did not confirm a successful entry.
(3) Take process and workplace safety requirements into account.		Iterative Prototyping	Users handle chemicals and require instructions during the process.
(4) Using peripheral devices to optimizes interoperability and the human-computer interface.	[28]	Sketching Solution, Iterative Prototyping	Users faced problems to scan barcodes with the camera. Instead, a barcode scanner ring could be added to the system.
(5) Design a Simple and consistent layout to avoid complexity	[21], [26], [27], [8]	Sketching Solution, Iterative Prototyping	Strongly differing layouts and forms of presentation irritate the user.
(6) Focus perceptible user interface design to ensure usability.	[18], [21], [26], [27],	Embedding concepts and Techniques	Some manufacturers provide specific information for display on the devices, but these are not transferable to other products.

Design Principle	Literature	Design Heuristics	Example
(7) Offer customizable interface to respect individual user requirements.	[28]	Iterative Prototyping	During the evaluation of a prototype with different people, differing requirements were placed on the user interface.
(8) Focus on the essentials.	[8], [18]	Iterative Prototyping	Implementers with experience in app development for smartphones tend to design the user interface and the information to be displayed too complex for smart glasses-based systems.
(9) Match the user's qualification.	[8]	Sketching Solution	Different user groups require a differing degree of detailing and additional information for process support.
(10) Provide continuous navigation and orientation.	[8], [38]	Iterative Prototyping	A progress bar provides users with an overview of the process step in which they are.
(11) Privacy is a design goal.	[19], [28], [45]	Sketching Solution	The regulations of the GDRP must be complied with for industrial use. Privacy-by-design is a fundamental principle to be integrated into system development.
(12) Use of Random Access Memory (RAM) economically.		Iterative Prototyping	The application has a high latency time or the smart glasses have already heated up after a short period of use.
(13) Choose software components according to usage context.		Iterative Prototyping	For step-by-step instructions, a different language application and library is suitable than for speech-to-text scenarios.
(14) Modular software design allows a customizable range of functions	[19], [28]	Iterative Prototyping	Technical and functional modules of already existing prototypes could be integrated in the implementation of new use cases. Thus a registration mask or a video recording function of different prototypes has been realized with the same system module.
(15) Scalable software architecture enables the future expansion of such young technology.	[19]	Sketching Solution	So far, smart glasses have initially been used as prototypes. However, the corresponding solutions should be scalable in order to enable broad use in the future. So far
(16) Use external sensors and interfaces to collaborate with others users and the overall system environments		Sketching Solution	In order to develop smart services, external sensor data, e.g. from machines to be maintained, are required.